The Local Polynomial Method for characterization of spatial and temporal variability of groundwater-surface water interaction

Christian Anibas* & Marijke Huysmans
Department of Hydrology and Hydraulic Engineering – Vrije Universiteit Brussel, Brussels, Belgium
canibas@vub.ac.be
Uwe Schneidewind[1] & Ingeborg Joris
Environmental Modeling Unit – Flemish Institute for Technological Research (VITO), Mol, Belgium
[1]Department of Soil Management - Ghent University, Ghent, Belgium
Gerd Vandersteen
Department of Fundamental Electricity and Instrumentation – Vrije Universiteit Brussel, Brussels, Belgium
Okke Batelaan
School of the Environment – Flinders University, Adelaide, Australia

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ABSTRACT

In rivers exchange fluxes of water are sensitive to local and regional factors, like riverbed conductivity and hydraulic gradients. Depending on the spatial scale, events and periodic changes of groundwater-surface water interaction have different effects. Therefore a hierarchical approach for investigating and interpreting groundwater-surface water interaction is suggested. To achieve this, the accuracy and representativeness of field measurements must be improved and related uncertainties have to be estimated. Temporal and spatial heterogeneities also have to be properly incorporated into transport models. To exemplify this scheme, a coordinated combination of field investigations and novel data processing and characterization tools, geographical information systems and geostatistics is presented. The aim is to study the variability of groundwater-surface water interaction of a streams hyporheic zone located in Belgium. A new analytical tool, the Local Polynomial Method (LPM) joined with a Maximum Likelihood Estimator (MLE) is applied. This methodology combines the frequency response of measured temperature time series and a non-linear optimization technique (i.e. a MLE). It is a flexible and fast tool able to create time series of exchange fluxes, their model quality and parameter uncertainty. In conjunction with hydraulic head measurements and soil sample analysis at multiple locations the LPM allows the assessment of spatial patterns of water fluxes and of thermal and hydraulic sediment parameters. Seepage meter measurements are used for validation. In gaining more reliable quantitative information on groundwater-surface water interaction model confidence is improved. This helps to develop more effective procedures for the assessment and management of water resources and the conservation of their ecosystems.